2004

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This proposal seeks to exploit a new capability in ocean observing systems that will enable the space and time mapping of surface currents over an entire coastal upwelling system, including associated jets and eddies. The capability involves the use of High Frequency (HF) radar instruments deployed along the shoreline. The new aspect of these measurements is that it is proposed to use systems tuned to the low-frequency end of the HF band, around 5 MHz, rather than the now commonly used systems that operate between 12 MHz and 25 MHz. The difference in range capability is dramatic. The standard systems typically measure 30 km to 50 km from shore with range resolution on the order of 2 km. New data presented here shows that these same instruments operating at 5 MHz are capable of measuring 200 km from shore with range resolution on the order of 6 km. This range has been proven by combining the very efficient transmitter technology contained in the commercially available CODAR/SeaSonde with a tuned transmit antenna produced for the University of Michigan's Multifrequency Coastal Radar (MCR).

We propose to use a three-site array of these radars to obtain a three-year time-series of daily maps of mesoscale surface currents over an area approximately 350 km x 180 km in extent, centered on Cape Blanco, Oregon. This region is the planned focus of intense in-situ biophysical sampling over a range of space and time scales during the GLOBEC Northeast Pacific (NEP) program. Recent studies show that Cape Blanco is often a separation point in physical regimes during the upwelling season, where a shelf-trapped alongshore current jet to the north separates from the coast and flows offshore, leaving an eddy- rich regime further south (Smith, 1995; Barth and Smith, 1998). A core hypothesis of GLOBEC NEP is that spatial and temporal variability in mesoscale circulation dominates the physical forcing on zooplankton production, distribution, retention and loss in coastal regions.

The radar-derived maps will be used to study the properties of the eddies and jets, and the pathways of particles in the surface layer. We will examine the instances of eddy generation, to determine their frequency of formation, whether they occur preferentially at particular locations, in response to particular wind-forcing events, in winter as well as summer. The propagation characteristics and time-space variations in intensity and scale will be examined. Eddy-jet and eddy-eddy interactions are expected to be well captured by the radar, which can make observations through periods of cloudy skies. Statistics of jet core location and speed will be determined through the seasons, and the relationship between separation events and wind forcing will be examined. We will generate tracks of pseudo-Lagrangian particles as a guide to particle fates. Other GLOBEC components, including LTOP, mesoscale and process studies in the region, will provide complementary in-situ biological and subsurface physical measurements. Moreover, the current maps will also provide pre-cruise and at-sea guidance for the GLOBEC mesoscale and process studies, as well as information on local time variations during the cruise. Time-series maps of mesoscale currents will provide test cases for modelers. They will also complement satellite remote sensing of surface temperature, ocean color, and surface height.

Statement of Work for Year 1 (October 1, 1999 to September 30, 2000)

We propose to acquire, install, test and begin routine operation of an array of three modified SeaSonde HF radars in a new long-range, low-frequency mode, to straddle the region north and south of Cape Blanco, Oregon. Once operational, this system will be used to produce a continuous time-series of maps of surface currents in the region, over an area expected to extend 350 km alongshore and nearly 200 km offshore, with

spatial resolution of 5-10 km. We will begin collaboration with groups conducting the regional mesoscale and process studies by making the current maps available electronically in near real-time, as a planning aid for sampling.

This page was last updated on March 15, 2007.

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